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An analysis of the following factors to determine which predict success in aeronautical engineering, air maintenance, or air transportation curricula: High school rank; number of high school units completed and credit point average in high school science, English, and mathematics; span of years from high school to college; ACE (American Council on Education) linguistic, quantitative, and total scores; and Engineering and Physical Science Aptitude Test total score.							
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ST LOUIS UNIV

DETERMINATION AND EVALUATION OF

SIGNIFICANT FACTORS IN SELECTION OF STUDENTS

FOR THE THREE CURRICULA AT PARKS COLLEGE

(A Study Conducted by the Bureau of Institutional Research, under the
Direction of G. F. Anderhalter)

The Problem

The increase in the number of applicants for admission to one of the three Parks College curricula during the past years has made it necessary to select from amongst the applicants. In any such situation, it is extremely desirable to utilize such factors in the selection of students which will prove to be valid indicators of the potentiality of the applicants.

The purpose of this study, is therefore, to analyze the various factors that are available for each applicant upon application, in view of determining the degree to which each does indicate student potential. Since it is quite possible that factors which are valid indicators in the aeronautical engineering curriculum may not be valid in the air maintenance or air transportation curricula, a separate analysis is necessary for each of these curricula.

The Population for the Study

In view of the fact that any factor might prove to be reliable immediate predictor (i.e. will predict success during first year, or first semester) but might not prove reliable for final overall prediction; or that any single factor might prove to be reliable as a predictor of success in Mathematics, but not in the sciences; etc.; it appeared necessary to evaluate each factor on different criteria--including indications of immediate and overall success in the course, indications of success in math, sciences and others, etc.

For this reason, the population for the study had to be selected so that all criterion measures, as well as all pre-measures were available. The groups who entered Parks College in the fall of 1949 were consequently selected. This

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group provides the necessary data, and was far enough from the end of World War II as to be more typical of the present type of students.

Factors Evaluated & Criterion Measures Used

The specific measures which were evaluated in the study--all of which are available for every applicant to one of the three curricula at Parks--were:

1. The applicant's High School Rank (in percentile terms)
2. The number of High School Units completed in Math.
3. The Credit Point Average in Mathematics in High School
4. The number of High School Science Units completed
5. The Credit Point Average in High School Science
6. The number of High School English Units completed
7. The Credit Point Average in High School English
8. The span (in years) from high school to college
9. The A.C.E. score on Quantitative
10. The A.C.E. score on Linguistic
11. The A.C.E. total score
12. The Engineering & Physical Science Aptitude Test total score

The criteria against which each of the preceding measures were evaluated were:

- A. the 2nd Semester Math. Average at Parks
- B. the 2nd Semester Physics Average at Parks
- C. the 2nd Semester total Credit Point Average at Parks
- D. the 6th Semester credit point average in Math. at Parks
- E. the 7th Semester total credit point Average at Parks

Procedure

In the case of the Aeronautical Engineering curriculum students (in which the majority of students fall), each of the pre-measures was correlated with each of the criterion measures. Since most of the measures fall into a limited number of categories (as grades, A, B, C, D, or F), the coefficient of mean square contingency (designed for this purpose) was used, except for a limited of cases in which the presence of a dichotomy dictated the use of a tetrachoric coefficient of correlation.

For the Air Maintenance, and Air Transportation curricula, each of the pre-measures was correlated with the 2nd semester credit point average and the 7th semester credit point average only. This was done since the limited

number of students in those two groups did not justify the computation of the other coefficients, particularly when the results on the Aeronautical Engineering group revealed that the results from the other coefficients led to essentially the same conclusions as those derived from the 2nd semester and 7th semester averages.

Results

The results from the correlational analysis are presented in table which follows. In all cases, the pre-measures are listed vertically along the left hand scale, and the criterion measures for each curricula are listed across the top.

The coefficients of correlation which have a star appearing next to them are significantly greater than zero. (It can be noted that for the first two curricula, a correlation of approximately .59 is necessary for significance, and for the last curriculum, a correlation of approximately .65 is necessary--the relatively small number of individuals on which the correlations were determined requires such a magnitude for significance). Any significant correlation can be interpreted to indicate reasonable assurance that there is definitely a relationship present--and that such a relationship could be present if thousands of individuals had been used for the study---in other words, in spite of the small group, we could not expect a value this large from this size of group, if the correlation in the entire population were zero.

Table 1.--Results of Correlational Analysis

Pre-Measures	Aero. Eng. Curriculum					Air. Main.		Air Tran.	
	Criterion Measures*					Cri. M.		Cri. M.	
	A	B	C	D	E	C	E	C	E
H.S. Rank	.04	.35	.48	.67*	.74*	.66*	.55	.38	.68*
H.S. Units in Math	.28	.28	.50	.46	.83*	.14	.10	.10	0
CPA in H. S. Math	.17	.36	.20	.69*	.58*	.56*	.46	.07	.43
H.S. Units in Science	.41	.43	.44	.26	.53	.37	.05	.16	.01
CPA in H.S. Science	.52	.39	.44	.21	.46	.75*	.75*	.70*	.75*
H.S. Units in English	0	.40	.64*	.47	.35	.41	.02	.17	0
CPA in H.S. English	.21	.45	.24	.75*	.85*	.30	.25	.15	.03
Years between H.S. & College	.58*	.87*	.46*	.63*	.71*	.40	00	.54	.70*
ACE Q-score	.53	.03	.81*	.36	.50	.05	.10	.15	0
ACE L-score	.44	.37	.62*	.55	.59*	.51	.63*	.15	.77*
ACE Total	.51	.41	.58*	.44	.56	.51	.73*	.16	.40
Eng. & PHY. Sci. Apt. test score	.20	.59*	.53	.56	.54	.13	.64*	.14	.81*

*The Key for Criterion Measures is as follows:

- A--2nd semester Math Average
- B--2nd semester Physics Average
- C--2nd semester credit point average
- D--6th semester Math Average
- E--7th semester credit point average

Resulting Evaluation of Pre-Measures

On the basis of the results reported in table one, the following evaluations can be applied to the specific pre-measures:

1. HIGH SCHOOL RANK

- a. Relative to Aero. Eng. Curriculum--The high school rank appears to be quite valuable in the selection of aeronautical engineering students. While its reliability is not significant for the first three criterion measures--representing immediate success--it is significant for the last two criteria--representing the more important overall success.
- b. Relative to Air Maintenance Curriculum--The high school rank again appears to be valuable here, particularly in terms of the 6th semesters work. The value for the 7th semester is just barely under the significant level, but in terms of the 6th semester value can be taken as significant.
- c. Relative to Air Transportation Curriculum--Here again, the high school rank appears to be a significant predictor of final overall success. As in the case of the Aero. Eng. group, it does not serve as well as an indication of immediate success, but does correlate significantly with the more important criterion of overall success.
- d. General Summary--The high school rank appears to be valuable in all three curricula for the purpose of indicating expected final overall success. In most cases, the success of students during the initial training stages will not be indicated. It is likely that the perseverance inherent in such an index is probable cause for this predicative efficiency overall.

2. NUMBER OF HIGH SCHOOL UNITS IN MATHEMATICS

- a. Relative to Aero. Engineering Curriculum--As in the case of the high school rank, this measure appears to be valuable primarily in indicating final overall success. Correlation based on more immediate criterion (as 2nd semester) are not significant. It is somewhat significant that the correlation is much higher for indicating 7th semester proficiency than in indicating 6th semester math. average.
- b. Relative to Air Maintenance & Air Transportation Curricula--The measure appears to have little value in either of these curricula. In no case is the correlation significantly different from zero.
- c. General Summary--In the Aero. Eng. curriculum, the measure appears to have long range predicative efficiency--indicating success in 7th semester average. It has little value in either of the other two curricula.

3. CREDIT POINT AVERAGE IN HIGH SCHOOL MATH

- a. Relative to Aero. Eng. Curriculum.--As in the case of the number of units in math., this measure appears to have value for predicting long range success, as well as overall success in mathematics. Its value for immediate success (during first 2 semesters) is limited. Because of the significant correlation with 6th semester math average, it appears to be slightly better than the number of units in math.
- b. Relative to Air Maintenance Curriculum.--The measure has almost a significant correlation with the 2nd semester average, but falls far short of being valuable toward indicating overall success in this curriculum (r equal .46 with 7th year).
- c. Relative to Air Transportation Curriculum.--The measure appears to have little value in this curriculum, even toward indicating success in the immediate courses.
- d. General Summary.--The measure appears to be valuable for indicating overall success in the Aero. Eng. curriculum, but not immediate success. For the Air Maint. group, its value restricted to indicating immediate success (first two years), and it has little value at all for the Air Trans. curriculum.

4. NUMBER OF HIGH SCHOOL UNITS IN SCIENCE

- a. Relative to Aero. Eng. Curriculum.--In no case is the correlation significantly greater than zero, although all of the correlations range around .4. It is possible that this measure is of limited value toward indicating success in this field.
- b. Relative to other two Curricula.--None of the correlations are significantly greater than zero. One correlation is fairly largely negative. The measure has little value in these curriculum.
- c. General Summary.--The measure appears to have no value in the Air Tran. and Air Maint. curricula, and only probable limited value in the Aero. Eng. Curriculum.

5. CREDIT POINT AVERAGE IN HIGH SCHOOL SCIENCE

- a. Relative to Aero. Eng. Curriculum.--As in the case of the number of units in science, no correlation is significantly greater than zero, although most of them range around .4. Again, it is possible that this measure is of limited value toward indicating success in this field.
- b. Relative to Air Maintenance.--In this curriculum this measure appears to be the best of all in-so-far as indicating both immediate and final success. Correlation with 2nd semester and 7th semester averages are both significant.
- c. Relative to Air Trans.--Here both correlations shown are significantly negative--indicating that those with the highest averages in high school

science, have poorest grades. It is likely that, since this curriculum emphasizes other areas rather than sciences, students taking a lot of science in high school fall short in other areas required in this curriculum.

- d. General Summary.--The measure appears to have only limited value in the Aero. Eng. Curriculum, but is extremely efficient for both immediate and final success in the Air Maintenance curriculum. The extreme difference between the high positive correlations for the Air Maintenance, and the high negative correlations for the Air Transportation appear to make this measure valuable toward differentiating between these two curricula. (i.e. those with high CPA's would be pointed toward Maintenance, and those with low CPA's would appear better suited in the Air Trans.)

6. NUMBER OF UNITS IN ENGLISH

- a. Relative to Aero. Eng. Curriculum.--All correlations are negative, with one (2nd semester average) being significantly negative. It appears that those taking a large number of English units miss other necessary courses and consequently do poorly in Engineering. The measure might be of value in eliminating students, rather than selecting.
- b. Relative to other two curricula.--No correlation for either group is significantly greater than zero. Little or no value for selection.
- c. General Summary.--Since we again have a case of zero or small positive correlation for the last two curricula, and significant negative correlation for the Aero. Eng. curricula, this measure might be used effectively for differentiating between these curricula. A person with many units of English might be steered into one of the last two curricula where it has no effect, rather than in Aero. Eng. where it would probably have a detrimental effect.

7. CREDIT POINT AVERAGE IN ENGLISH

- a. Relative to Aero. Eng. Curriculum.--Contrary to the number of units in English, this measure has a significant correlation with the 6th semester and 7th semester criteria. This is not contradictory, since good linguistic ability appears essential for the reading, etc. required in this more academic course. As previously mentioned, it is likely that good success in English is valuable for indicating success, but if too many units are taken, other background courses were likely omitted causing poor success in college.
- b. Relative to Other two Curricula.--As in the case of the , of units, this measure appears to have little value in predicting success in either of these two curricula.
- c. General Summary.--Again, it appears that this measure is valuable for indicating success in the Aero. Eng. curriculum, as well as for differentiating between the Aero. Eng. group and the other two. Those with a high average in English (but not too many units) would probably do well in the Aero. Eng. curriculum, while those with a low average (with either few or many units) would probably do better in Maintenance.

8. NUMBER OF YEARS BETWEEN HIGH SCHOOL AND COLLEGE

- a. Relative to Aero. Eng., and Air Trans.--In the case of both of these curricula all correlations are significant or just below significant (in case of one measure it is .54). It appears that those with most time between high school and college do better in these courses, even on immediate achievement.
- b. Relative to Air Maintenance.--In this curriculum, there appears to be little if any value of the measure.
- c. General Summary.--The measure appears to be indicative of success, both immediate and long range, in the Aero. Eng. and Air Trans. curricula, but of little value in the Air Maintenance curriculum.

9. ACE QUANTITATIVE SCORE

- a. Relative to Aero. Eng. Curriculum.--The measure appears to be of some value for indicating immediate success in view of the significant correlation with 2nd semester average. However, it loses its significance in terms of long range success. Since all of the correlations are positive and relatively high, the measure appears to have limited value, particularly toward indicating immediate success.
- b. Relative to Other two Curricula.--In the case of these two curricula, none of the correlations differ significantly from zero. Little if any value in these cases.
- c. General Summary.--Surprisingly, this measure is of only limited value in the Aero. Eng. Curriculum--and then primarily for indicating immediate success--and of little value at all in the other two curricula.

10. ACE LINGUISTIC SCORE

- a. Relative to Aero. Eng. Curriculum.--Surprisingly, this measure appears to be far more significant in terms of both immediate and long range success than was the Q score. All correlations are relatively high positive, and both the 2nd semester and 7th semester averages correlate significantly.
- b. Relative to Other two Curricula.--Here again, the correlations with long range achievement is significant. The measure does not adequately indicate immediate achievement but does correlate significantly with 7th semester average.
- c. General Summary.--This measure appears to be very valuable in all three curricula. In the case of the Aero. Eng. curriculum, it indicates significantly, both immediate and long range success, and for the other two curricula, it adequately indicates long range success.

11. ACE TOTAL SCORE

Much the same that has been said of the ACE Linguistic can be said of the ACE total score. Since the correlations are somewhat lower than in the case

of the Linguistic (probably due to the negative effects of the Quantitative score that goes into the total score), the Linguistic score would be more desirable since only one of the two should be used (due to the fact that the two measures are overlapping)

12. ENGINEERING & PHYSICAL SCIENCE ATTITUDE TEST TOTAL SCORE

General Summary.--As in the case of the ACE Linguistic score, this measure appears to significantly correlate with both immediate and long range success in the Aero. Eng. Curriculum, and significantly correlate with long range success in the other two curricula. For the Aero. Eng. group, it appears to indicate success in Sciences better than in Math., although overall success in 7th year yields a significant correlation.

Significant Factors in Each Curriculum

Having evaluated each measure separately, it now remains to summarize the findings in terms of significant factors in each curriculum.

1. Aeronautical Engineering Curriculum.

- a. In terms of Long range Success the following measures appear to be of significant value:

High School Rank
#Units of H. S. Math.
C.P.A. in H. S. Math.
C.P.A. in H. S. English
ACE Linguistic Score
years between high school and college

and the following appear to be of limited value:

Eng. & Phy. Sci. Aptitude Total Score
Units of H. S. Science

- b. In terms of more immediate success (as shown by 2nd semester average) the following are of significant value:

years between high school & college
ACE Q score
ACE L score

- c. In addition, the following measures are of value for the indicated purpose:

Years between H. S. & college--for indicating both Math & Physics
potentiality

Eng. & Phy. Sci. Aptitude-----for indicating potentiality in Physics

H. S. Rank & CPA in Math.-----for indicating potentiality in 6th
semester math. average

2. Air Maintenance Curriculum.

- a. In terms of long range success the following measures appear to be of
significant value:

CPA in H. S. Science
ACE Linguistic Score
ACE Total Score
Eng. & Phy. Sci. Apt. total score

and of limited value are:

High School Rank

- b. In terms of more immediate success (at end of 2nd semester), the
significant factors appear to be:

High School Rank
CPA in H. S. Science

and of limited value is:

CPA in H. S. Math.

3. Air Transportation Curriculum.

- a. In terms of long range success the following measures appear to be of
significant value:

High School Rank
Years between H. S. & College
ACE Linguistic Score
Eng. & Phy. Sci. Aptitude total score

- b. In terms of more immediate success, the following appear to be of some
limited value:

Years between H. S. & college

Factors Differentiating Between Curricula

While the specific factors that are of value in selecting students in each of

the curricula, as indicated in the preceding section, in themselves help to differentiate between the various curricula: there are a number of points of special significance in this regard which are listed below.

- a. In view of the high significance of # Units in H. S. Math. in Aero. Eng. Curriculum, and the little significance in the other two, the presence of a large number of such units would be one basis for steering an individual into the Aero. Eng. Curriculum rather than the other two.
- b. The CPA in High School Math. would be another indication for this same purpose, even though the number of units is not large. The long range predictive value, shows a closer correspondence between such an average and success in the Aero. Eng. Curriculum than it does for the other two. This measure is stronger for steering an individual out of the Air Transportation group, than it is for steering specifically into the Aero. Eng. Curriculum (since Aero. Eng. and Air Maint. are not too different in this respect).
- c. In view of the consistently positive correlations for the Aero. Eng. group in the # of H. S. Science Units, as against zero or negative values for the other two curricula, this measure would be another basis for steering an individual with a lot of sciences in high school into the Aero. Eng. curriculum.
- d. The CPA in H. S. Science (independent of the number of courses) is of primary importance in distinguishing between the Aero. Engineering and Air Maintenance groups on one hand, and the Air Transportation groups on the other. It appears that having a high average in sciences is associated with poor achievement in Air transportation, but significantly high achievement in Air Maintenance (also high for Aero. Eng., but not significant). This is based upon the high positive r's for Maintenance (and medium positive r's for Aero. Eng.) as versus the significant negative correlations for Air Transportation.
- e. The presence of a large number of English Units would appear to be a basis for steering a student away from the Aero. Eng. Curriculum. All correlations in this group are negative, indicating that presence of a large number is associated with poor success in the curriculum, while it has little or no effect in the other two curricula.
- f. A high credit point average in English (when associated with a small number of courses) would be a basis for steering an individual into Aero. Engineering. This is based upon the significant relation between CPA in English and overall success at Parks in the Aero. Eng. curriculum, as compared to no significant relation in the other two curricula.
- g. A high ACE Q. score would provide a basis for steering an individual into the Aero. Eng. Curriculum rather than either of the other two. This is based upon the number of significant correlations for this measure in the Aero. Eng. Curriculum (and generally high positive correlation), as compared to zero or near zero correlations in the other two. Those with a high Q. score tend to be at the top in the Aero. Eng. course, but have no relationship with success in the other two.